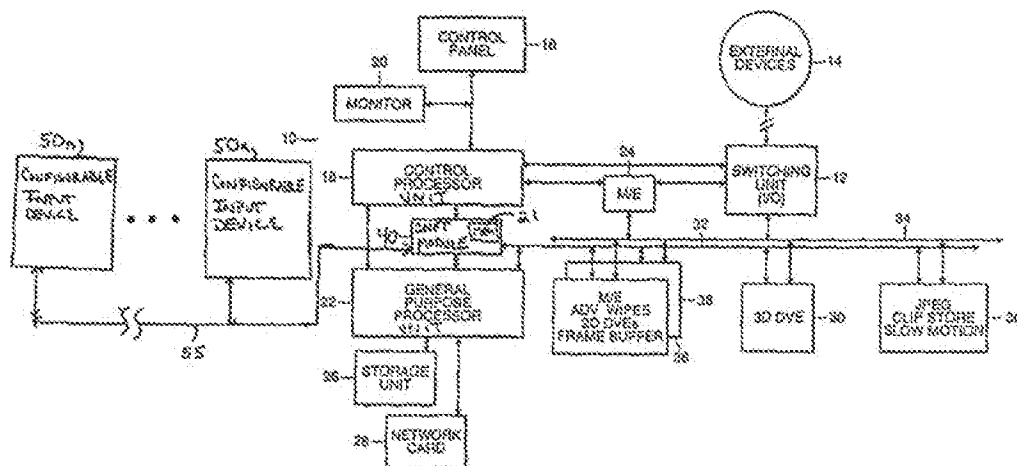




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(54) Title: CONFIGURABLE INPUT DEVICE FOR A DIGITAL VIDEO SWITCHER



## (57) Abstract

A digital video switcher processes video signals in a production environment. The switcher can include a control panel and at least one configurable input device for receiving operator inputs and a switching unit for receiving video input signals and for providing video output signals. The switcher also includes a plurality of tightly coupled, independent processors (i.e., at least one control processor and at least one general purpose processor) synchronized to the video frame rate. The at least one control processor controls the "live critical" production functions. The at least one control processor provides control signals, in response to operator inputs, such control signals programming the switching unit to provide desired video output signals in real time. The at least one general purpose processor runs an open architecture operating system and provides control signals, in response to operator inputs, that cause the switching unit to provide desired video output signals in real time.

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## CONFIGURABLE INPUT DEVICE FOR A DIGITAL VIDEO SWITCHER

## Cross-Reference to Related Applications

This application is a continuation-in-part of U.S. patent application serial number 09/286,253 which was filed on April 05, 1999. In addition, this application claims priority to U.S. provisional application Serial No. 60/127,921, filed April 06, 1999 and U.S. provisional application Serial No. 60/153,132, filed September 09, 1999. These copending applications are  
5 incorporated herein by reference in their entirety.

## Field of the Invention

The invention relates generally to digital video switchers. More particularly, the invention relates to using a configurable input device to control a digital video switcher.

## 10 Background

In television programming, video switchers receive video input signals from various video sources and direct (or "switch") to the switcher outputs for transmission (or recording) picture images from selected sources. The video sources can include network feeds, satellite feeds, cameras, receivers and recorders. Switching can be done manually by an operator or  
15 automatically by programming the switcher to perform a plurality of operations (or "transitions") in a predetermined sequence. Transitions can include cuts, fades, wipes and combinations thereof.

A conventional video switcher typically includes a switching unit, mix/effects (M/E) amplifiers, a control processor and a control panel. An operator manipulates various knobs,  
20 levers, and switches on the control panel. The control panel can be large and intimidating to an inexperienced user. Also, a single control panel requires all operators to be physically located at

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the control panel, presenting logistical problems. The control processor controls the switching unit and M/E amplifiers to provide the video output signal. The switching unit receives video input signals and provides the input signals to the M/E amplifiers. The M/E amplifiers, responsive to control signals from the control processor, combine selected input signals to produce a video output signal. For convention switchers capable of supporting live broadcasts, the control processor is synchronized to the video frame rate and provides real time switching functionality within 1/60th of a second.

Over the years, video switchers have utilized various types of technology. Known analog video switchers have used analog circuitry and a single processor running a proprietary closed architecture operating system. Known digital switchers have used one or more processors running a proprietary closed architecture operating system. For example, the Grass Valley Group manufactures a digital production switcher (Model 2200™) having multiple processors running a proprietary closed architecture operating system. These closed architecture switchers are essentially fixed in their capabilities when manufactured and are generally not upgradeable by third parties.

In recent years, video switcher companies have attempted to take advantage of the increased capability of standard platform computing systems (i.e., PC-based open architecture systems). By way of example, Pinnacle manufactures a digital switcher (Alladin™) that operates in conjunction with a personal computer (PC). The switcher couples to the PC through a SCSI port. The switcher includes a control processor running a proprietary closed architecture operating system, and the PC includes a general purpose processor running an open architecture operating system. The control processor provides real time switching for live broadcasting. The PC processor provides non-real time switching (e.g., off-line image processing and image storage), but is incapable of providing real time switching functionality. In another example,

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Matrox manufactures a digital switcher (DigiMix™) that includes standard platform computing capability. More specifically, the switcher includes a control processor and a general purpose processor. However, the two processors are not independent of each other, and the general purpose processor is not synchronized to the video frame rate. Thus, the switcher is incapable of providing real time switching functionality.

The assignee of the subject application, e-studioLIVE, Inc., manufactures two switching products that include standard platform computing capability. e-studioLIVE's PC-A is a two-channel audio switcher on a standard IBM circuit card that can be plugged into a PC. e-studioLIVE's PC-3 is a video switcher on a standard IBM circuit card capable of being plugged into a PC. Both products can be controlled by an on-board control processor or a general purpose processor running the Windows™ operating system on the PC. After installation of either product in the PC, the two processors are independent of each other and tightly coupled.

The PC-3 is incapable of providing real time switching functionality in live broadcast environment for at least two reasons. First, the general purpose processor is not synchronized to the video frame rate. Second, Windows™ application software running on the general purpose processor provides the control panel as a window on the PC display. Thus, the control panel would not survive a PC failure in a broadcast environment.

It is therefore a principle object of the invention to provide a digital video switcher that includes an control panel and at least two processors (i.e., at least one general purpose processor running an open architecture operating system and at least one control processor running a second architecture operating system and supporting real time critical functions) configured so that the general purpose processor communicates with a configurable input device that can be used remotely from the control panel.

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## Summary of the Invention

The present invention features a digital video production switcher for processing a plurality of video signals in a production environment. The switcher includes a switching unit for receiving video input signals from various devices (e.g., network feeds, satellite feeds, cameras, receivers and recorders) and for providing video output signals. In one embodiment, the switcher includes a control panel for receiving operator inputs. The switcher also includes a control processor unit and a general purpose processor unit. The control processor unit includes at least one control processor. The general purpose processor unit includes at least one general purpose processor. In another embodiment, there is a second general purpose processor unit in communication with the general purpose processor unit, for example over a network. The plurality of independent processors synchronized to the video frame rate - at least one control processor and at least one general purpose processor. In one embodiment, the control and general purpose processors are tightly coupled to and independent of each other. They share a section of memory to allow for high bandwidth communications. The switcher also includes at least one configurable input device for receiving operator inputs.

The at least one control processor controls the "live critical" production functions (i.e., input/output video switching, mixing, wiping and keying). The at least one control processor is electrically connected to the switching unit and the control panel and supports control panel operations independent of the general purpose processor. The at least one control processor provides control signals, in response to operator inputs received from the control panel, that program the switching unit to provide desired video output signals in real time. In one embodiment, the at least one control processor runs a closed architecture operating system.

The at least one general purpose processor is in electrical communication to the switching unit, the control processor and the at least one configurable input device via a studio network

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module, which can include a dual port memory device. The at least one general purpose processor runs an open architecture operating system and generates control signals in response to operator inputs, received from the at least one control processor and from the at least one configurable input device. These control signals cause other processing units to process selected input signals and generate desired video output signals. The at least one general purpose processor programs the switching unit to provide the desired video output signals in real time. In one embodiment, the at least one general purpose processor is running a Windows™ NT operating system.

The switcher can also include various units that support live and post productions environments. A mix/effects amplifier can be electrically coupled to the switching unit and the processors. The mix/effects amplifier, in response to control signals from the processors, combines selected video input signals to produce desired video output signals. A storage unit can be coupled to the processors for storing video signals. A network interface unit can be coupled to the at least one general purpose processor for receiving video input signals and for providing video output signals over a local area network or a wide area network. A digital video effects unit can be coupled to the processors for processing of video input signals for generating special effects video output signals (e.g., page curls, flying video cubes, water ripples, spheres, highlights and shadows, and slats and waves). A multi-function video effects unit electrically coupled the at least one control and general purpose processors for providing JPEG clip store, still store and slow motion processing capabilities. A post-production digital video effects unit can be coupled to the processors for non-real time processing of video input signals for generating special effects video output signals.

In another aspect, the invention also features a configurable input device for receiving operator inputs to command a digital video switcher for processing a plurality of video signals.

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The configurable input device includes a display for displaying messages to an operator and a plurality of configurable input elements for receiving operator inputs. The configurable input device also includes a transceiver in communication with the display and the plurality of configurable input elements. The transceiver receives signals from the plurality of configurable input elements in response to an operator action. In addition, the transceiver receives from an external source, configuration information for the plurality of configurable input elements including a data set that is displayed on the display. In one embodiment, at least one configurable input element of the plurality of configurable input elements further comprises a display for displaying a color that represents a type of command to which the configurable input element corresponds. In another embodiment, at least one configurable input element of the plurality of configurable input elements further comprises a display for displaying one of a textual and a graphical representation of the command to which the configurable input element corresponds. For example, the elements can be depressable buttons that rely on reprogrammable bit-mapped technology.

The configurable input device has many advantages. The configurable input device is compact and reconfigurable. The configurable input device relieves logistical problems such as crowding around the control panel and controlling some of the switcher functions from a remote location. The configurable input device enables users to multi-task on the switcher.

## Brief Description of the Drawings

These and other features of the invention are more fully described below in the detailed description and accompanying drawings.

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FIG. 1a is a block diagram illustrating an embodiment of a digital video production switcher for processing a plurality of video signals in response to user inputs from one or more input devices in accordance with the invention.

FIG. 1b is a block diagram illustrating an embodiment of a digital video production switcher for processing a plurality of video signals in response to user inputs from one or more input devices communicating over a network in accordance with the invention.

FIG. 2 is a block diagram illustrating an embodiment of a configurable input device for a digital video production switcher for processing a plurality of video signals in accordance with the invention.

FIG. 3 is a block diagram illustrating an embodiment of a configurable input device for a digital video production switcher for processing a plurality of video signals in accordance with the invention.

#### Detailed Description

FIG. 1 is a block diagram of a digital video production switcher for processing a plurality of video signals. The assignee, e-studioLIVE, Inc., manufactures digital video production switchers (e.g., ECHOLab 5000 Series) incorporating the principles of the invention.

As shown, the switcher 10 includes a switching unit 12 for receiving video input signals from various external devices 14 (e.g., network feeds, satellite feeds, cameras, receivers and recorders) and for providing video output signals for television broadcasts. In one embodiment, the switching unit 12 has twenty-seven input channels and twelve output channels. A control panel 16 receives operator inputs and provides such inputs to a control processor within the control processor unit 18. The assignee, e-studioLIVE, Inc., manufactures control panels (e.g., ECHOLab Models 5500, 5800 or 5900) that can be used in the switcher 10. A configurable input device 50 also receives operator inputs and transmits such inputs to a general purpose processor

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within the general purpose processor unit 22. The configurable input device 50 receives configuration information about its input elements and display information about its display from the general purpose unit 22. The assignee, e-studioLIVE, Inc. manufactures configurable input devices 50 (e.g., ECHOlabs Commander) that can be used with the switcher 10. A monitor 20, which is electrically connected to the control panel 16 and the control processor unit 18, displays selected video output signals to the operator. The control processor unit 18 includes one or more control processors, and the general purpose processor unit 22 one or more general purpose processors. In another embodiment, additional general purpose processors can be in communication with the general purpose processor unit 22 over a network communication channel. For example, a second general purpose processor unit 22', FIG. 1b can be in communication with the general purpose processor unit 22 over a network 58, FIG. 1b (e.g., the Internet) using a network card 28. The control processor unit 18 is electrically connected to the switching unit 12 and the control panel 16. The general purpose processor unit 22 is electrically connected to the switching unit 12 and the control processor unit 18.

The switcher 10 includes multiple independent processors (i.e., at least one control processor and at least one general purpose processor) synchronized to the video frame rate. The processors are "tightly coupled" in that they share a section of a dual port memory 21 to allow for high bandwidth interprocessor communications. The processors are in electrical communication with each other using a synchronous serial interface, in one embodiment, a studio net module 40 ("SNET module"). In one embodiment, the dual port memory 21 is located on the SNET module 40, as shown in FIG. 1. Through the SNET module 40 a connected processor is informed of every operation performed on the switcher 10 and the connected processor can make its own requests of the switcher 10. Both processor units are synchronized to the video frame rate (i.e., 1/60th of a second) and, therefore, can provide desired video output signals in real time. More

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specifically, the control processor unit 18 drives the general purpose processor unit 22 with frame accurate control over the devices (e.g., video cards) controlled by the general purpose processor unit 22. Also, the video processing operations are partitioned between the two processor units to provide "fail-safe" switching operations in a live broadcast environment. The general purpose processor unit 22 is also in electrical communication with at least one configurable input device 50, via the SNET module 40. The exemplary embodiment of FIG. 1a depicts multiple configurable input devices 50a, 50n in communication with the SNET module 40 through a communication channel 55 (e.g., RS485, RJ-45). The communication channel 55 connects the configurable input devices 50a, 50n in a parallel, daisy-chain fashion.

Another exemplary embodiment of FIG. 1b depicts the configurable input devices 50b, 50c in communication with the general purpose processor unit 22 over a network 58 (e.g., a LAN, a WAN, the Internet). Each configurable input device 50a, 50n operates as a separate network appliance either directly or indirectly (e.g., through a computer) connected to the network 58. The general purpose processor unit 22 is in communication with the network 58 using the network card 28. Another embodiment can include a video streaming server 53 (e.g., RealNetworks™ G2 server) in communication with the network card 28. The users of the configurable input devices 50b, 50c are also connected to the video streaming server 53 over the network 58, using a personal web browser on a computer. The web browser can have multiple views. The users use the configurable input device 50b, 50c to control what is displayed on their personal web browsers. For example, the user can use the configurable input device 50b, 50c to select which live video source or remote camera to use. The user can control data, titles and effects. The user can also control devices, such as the video stream server 53 or the video switcher 10, if the configurable input device 50b, 50c is configured to perform such control. If the configurable input device 50b, 50c is not configured to perform such control, the user can

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simply reconfigure the configurable input device 50b, 50c to obtain such control. In another embodiment, all operator inputs are received by the remote configurable input devices 50b, 50c that are on the network 58 and the control panel 16 is not used and is not connected.

Referring again more specifically to the switcher 10, the control processor unit 18  
5 controls the "live critical" production functions and supports control panel 16 operations independent of the general purpose processor unit 22. During a broadcast, the "live critical" functions include input/output video switching and mix-effect control functions (i.e., mixing, wiping and keying).

In one embodiment, the control processor unit 18 runs a closed architecture operating  
10 system. The control processor unit 18 provides control signals, in response to operator inputs via the control panel 16, that cause other processing units (22, 24, 26, 28, 30) to process selected input signals and generate a desired video output signal. The control processor unit 18 programs the switching unit 12 to provide desired video output signal in real time.

The general purpose processor unit 22 hosts an open architecture operating system and  
15 provides real time and non-real time control of open architecture peripherals and other networked peripherals. In one embodiment, the general purpose processor unit 22 includes one or more Pentium™ processors running a Windows™ NT operating system. The general purpose processor unit 22 provides control signals, in response to operator inputs, that cause the other processing units (24, 26, 28, 30) to process selected input signals and generate a desired video  
20 output signal. The control processor unit 22 programs the switching unit 12 to provide desired video output signal in real time.

The switcher 10 can be configured to include any combination of one or more control and general purpose processors. In one sample embodiment, the control processor unit is comprised of a pair of processors and the general purpose processor unit is comprised of a single processor.

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In another sample embodiment, both the control and general purpose processor units are comprised of a pair of processors.

The switcher 10 includes various processing units to provide complete support for both live broadcast and post production environments. A mix/effects (M/E) amplifier 24 is  
5 electrically coupled to the switching unit 12, the control processor unit 18 and the general purpose processor unit 22. The M/E amplifier 24 combines selected video input signals and produces desired video output signals. A storage unit 26 is coupled to the processor units for storing video signals and video processing and system software. The storage unit 26 can include disk and CD ROM bays and memory. A network interface unit 28 can be coupled to the general  
10 purpose processor unit 22 for receiving input signals from remote devices and for providing output signals to remote devices over a local area network or a wide area network. More specifically, the network interface unit 28 can be used for image transmission/reception, transfer of control information to/from a network device (e.g., a CG or routing switcher) and to send/receive time and control parameters to network devices.

15 A digital video effects (DVE) unit 30 is coupled to the two processor units via a PCI bus 32 and digital video interconnects 34 (e.g., ITL-R-601 video interconnects). In one embodiment, the DVE unit 30 is a GenieFusion™ 3D DVE manufactured by Pinnacle. The DVE unit 30 processes the video input signals and generates special effects video output signals. Such special effects can include page curls, flying video cubes, water ripples, spheres, highlights and shadows,  
20 and slats and waves. A multi-function video effects unit 36 can be coupled to the two processors via the buses 32, 34. The unit 36 provides JPEG clip store, still store and slow motion processing capabilities. In one embodiment, the unit 36 is a DigiMotion™ card manufactured by Matrox. At least one post-production digital video effects unit 38 can be coupled to the two processors for non-real time processing of video input signals for generating special effects video

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output signals. In one embodiment, the post-production digital video effects unit 38 is a DigiMix™ card manufactured by Matrox.

FIG. 2 is a block diagram depiction of a configurable input device 50. The configurable input device 50 includes a display 70 for displaying messages to an operator and a plurality of  
5 configurable input elements 80 for receiving operator inputs. The configurable input device 50 also includes a transceiver 60 in communication with the display 70 and the plurality of configurable input elements 80. The transceiver 60 receives signals from the plurality of configurable input elements 80 in response to an operator action. For example, the configurable input elements 80 can be reprogrammable buttons that the user presses to request a desired  
10 command. In another example, the buttons can be displayed on a touch screen that the user presses to request a desired command. The transceiver 60 transmits these signals to the general purpose processor unit 22.

The transceiver 60 receives from the general purpose processing unit 22 configuration information for each of the plurality of configurable input elements 80. This information is used  
15 by the configurable input device 50 to program each button. Once the buttons 80 have been programmed, the user can readily identify their functions based on display indicia that appears on the buttons. For example, certain configurable input elements 80 include a display for displaying a color to represent a type of command associated with the configurable input element. In this embodiment, the configuration information received from the general purpose  
20 processing unit 22 instructs the configurable input device 50 on which color to display for each configurable input element. For example, the configurable input elements 80 (e.g., buttons) that correspond to DVE commands are displayed with a red color.

In another embodiment, certain input elements 80 include a display for displaying either a textual and/or a graphical representation of the command to which the configurable input

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element corresponds. If the display is textual, the configuration information instructs the configurable input device 50 on which text is displayed on each configurable input element. For example, the configurable input element (e.g., button) that commands the video switcher 10 to start a predefined clip displays "Start Clip". If the display is graphical, the configuration  
5 information instructs the configurable input device 50 on which graphics are displayed on each configurable input element. For example, the configurable input element (e.g., button) that commands the video switcher 10 to wipe from the side displays the graphic of a square divided in two vertically, with the left side of the square white and the right side of the square black.

The transceiver 60 also receives from the general purpose processing unit 22 a data set  
10 that is displayed on the display 70. The display can include certain high-level information about the configuration of the configurable input device 50, the state of the video switcher 10 and/or the state of the configurable input device 50.

FIG. 3 is a more detailed depiction of one embodiment of the configurable input device 50'. This embodiment includes a display 70, such as a dot matrix display (e.g., part number  
15 HDM24416L-1-030P manufactured by Hantronix) that displays a number of lines of text. The first line in the display 70 "Jim's set-up" represents the high-level configuration information employed in the configurable input device 50'. The second line in the display 70 "Switch: Take Cam 3" represents the state of the video switcher 10, which is using camera 3 as the feed. This also provides feedback to the user to verify that the switcher has performed the requested  
20 command. The third line in the display 70 "Device: DPScIip 6:00 open" represents the state of the configurable input device 50', which is controlling the device DPScIip and the predefined clip that is being used is the opening sequence for the 6:00 news.

This embodiment also includes a plurality of individually configurable input elements 80. The individual configurable input elements are made up of three types of elements, simple push

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buttons (e.g., part number T5L-M-NOH manufactured by Datalux), rotary knobs (e.g., part number 91A1AB28B15 manufactured by Bourns) and push buttons with a matrix display (e.g., part number LC24.2 manufactured by Preh). There are four simple push button type configurable input elements 80a, 80b, 80c, 80d that control the display. For example, one

5 configurable input element 80d clears the display 70 when pressed by a user. In another embodiment, the commands corresponding to the four configurable input elements 80a, 80b, 80c, 80d can be defined to the user using the display 70 by listing on the display 70 the command, directly above the corresponding configurable input element. Also shown are simple push button

10 type configurable input elements that are used for number entry and motion control. The number entry and motion control buttons generally do not change with each change in the configuration of the configurable input device 50'.

The configurable input device 50' also includes four rotary knob type configurable input elements 80e, 80f, 80g, 80h. These configurable input elements 80e, 80f, 80g, 80h are used to control analog devices or enter commands with which an input range is associated. For example,

15 these configurable input elements 80e, 80f, 80g, 80h can control mix rate, wipe rate, vertical joystick control, horizontal joystick control and border size.

The configurable input device 50' also includes push buttons with a matrix display type configurable input elements 80j, 80k, 80m, 80p, 80q. The display of this type of configurable input elements 80j, 80k, 80m, 80p, 80q can display text and/or graphics and have backlighting of

20 many different colors. The colors that the configurable input elements display 80j, 80k, 80m, 80p, 80q can be predetermined by configuration information provided to the configurable input device 50'. The colors can be coordinated to represent the type of commands associated with the configurable input elements. For example, the configurable input element 80k can display red to represent a DVE command. The configurable input element 80m can display beige to represent a

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frequently used clip related command or clip related sequence of commands. Another example is green configurable input elements to represent commands that select control of a specific device (e.g., Pinnacle Xtreme, HP server, DPS Clips). Another example is orange configurable input elements to represent commands that select control of a desired router (e.g., router 1, router 2).  
5 Another example is brown configurable input elements to represent commands that select control of a VTR device (e.g., Sony VTR-1, Pana- VTR-2).

In addition to colors that represent the type of command, the configurable input elements 80j, 80k, 80m, 80p, 80q display text and/or graphics to represent the specific predefined command or sequence of commands to which the configurable input elements 80j, 80k, 80m,  
10 80p, 80q correspond. The dot matrix display allows the configurable input elements 80j, 80k, 80m, 80p, 80q to display any text and graphics that can be created within the limits of the resolution of the display. The text displays to the user of the configurable input device 50 the command to which the configurable input element corresponds. This command can change as the configuration information being used by the configurable input device 50' changes. For  
15 example, configurable input element 80m displays the text "Lead-out Clip". This text indicates to the user that under the current configuration information being used, "Jim's set-up" as shown in the display 70, the command that is executed when configurable input element 80m is pressed is to switch to the output of the switching unit 12 the clip in storage that is used for the lead-out. Configurable input elements 80j and 80k also are examples of text on the display that indicates to  
20 the user the command to which they correspond.

Instead of or in addition to displaying text, some configurable input elements (e.g., 80p and 80q) display graphic symbols representative of commands. The examples shown in the configurable input device 50' are a configurable input element 80p corresponding to a vertical wipe command and a configurable input element 80q corresponding to a horizontal wipe

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command. Whether a configurable input element displays graphics is determined by the user when defining the definition of the configuration and is based on the user's preference.

The general purpose processor unit 22 stores the configuration information for the configurable input device 50 as the user defines the configuration. The user defines the configuration using software that is executed by the general purpose processor unit 22. The user  
5 uses a monitor (not shown), a keyboard (not shown) and a mouse (not shown) that are in communication with the general purpose processor unit 22 to define the configuration. In one embodiment, the software is graphical and menu driven. The software displays the embodiment of the configurable input device 50 and allows the user to select a configurable input element,  
10 using a point and click method. The user then selects a command or sequence of commands that will correspond with the selected configurable input element. The user chooses the text and/or graphical representations that will be displayed on the configurable display element. The user can also select on and off colors for those configurable input elements that have the capability of displaying different colors. The user repeats the process until all of the configurable input  
15 elements that the user desires to configure have been configured. The user also selects a title for the configuration information the user has just created.

The user can create and define a wide variety of configurations for the configurable input device 50. The user can recall any previously defined set of configuration information using the configurable input device 50 itself. In one embodiment, the configurable input device 50' can  
20 have a "menu" button 80a. Depressing this button causes a menu of previously defined sets of configuration information to scroll down the display 70. When the user finds the desired configuration, the user presses the "load" button 80b. The selected set of configuration information is transmitted from the general purpose processor unit 22 to the configurable input device 50', which displays the appropriate indicia on the configurable input elements 80.

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The configuration information can also automatically change as the user pushes one of the configurable input elements associated with a command to control a specific device. For example, one of the configurable input elements can display the text "router 1" which represents that the command corresponding to that particular configurable input element is to take control of the specific device (i.e., the router 1 device). When the user pressed that configurable input element, the general processor unit 22 would automatically change the configuration information to the definition associated with that specific device (i.e., the router 1 device). Since the configuration information changed, the displays (e.g., color, text, graphics) of the configurable input elements (e.g., 80j, 80k, 80m, 80p, 80q) would change to reflect the new configuration information. The display 70 likewise is updated to reflect the new configuration information. For example, the first line of the display 70 changes to "Router 1 Control" and the third line changes to "Device: Router 1" to reflect the new configuration information.

#### Equivalents

While the invention has been particularly shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

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## Claims

1. A digital video switcher for processing video signals in a production environment comprising:
- a switching unit for receiving video input signals and for providing video output signals;
  - a control panel for receiving operator inputs;
  - a control processor unit electrically connected to the switching unit and the control panel, the control processor unit controlling production functions and being capable of providing control signals in response to operator inputs received from the control panel that program the switching unit to provide desired video output signals in real time;
  - at least one configurable input device for receiving additional operator inputs; and
  - a general purpose processor unit in electrical communication with the switching unit, the control processor unit, and the at least one configurable input device, the general purpose processor unit running an open architecture operating system and being capable of providing control signals in response to operator inputs received from (i) the control processor unit and (ii) the at least one configurable input device, such signals programming the switching unit to provide desired video output signals in real time;
  - the general purpose processor unit and the control processor unit being synchronized to the video frame rate, tightly coupled to and independent of each other.

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- 1    2.    The switcher of claim 1 further comprising a dual port memory electrically  
2        connected to the control processor unit and the general purpose processor unit.
- 1    3.    The switcher of claim 2 wherein the control processor unit and the general  
2        purpose processor unit share a section of the dual port memory to allow for high  
3        bandwidth communications.
- 1    4.    The switcher of claim 1 further comprising a second general purpose processor, in  
2        communication with the general purpose processor, for running an open  
3        architecture operating system and providing control signals in response to  
4        operator inputs received from (i) the control processor unit and (ii) the at least one  
5        configurable input device, such signals programming the switching unit to provide  
6        desired video output signals in real time.
- 1    5.    The switcher of claim 1 wherein the control processor unit further comprises at  
2        least one control processor.
- 1    6.    The switcher of claim 1 wherein the general purpose processor unit is running a  
2        Windows NT operating system.
- 1    7.    The switcher of claim 1 wherein the control processor unit supports control panel  
2        operations independent of the general purpose processor unit.
- 1    8.    The switcher of claim 1 further comprising at least one mix/effects amplifier  
2        electrically coupled to the switching unit and the control and general purpose  
3        processor units, the at least one mix/effects amplifier, in response to control  
4        signals from the control and general purpose processor units, combining selected  
5        video input signals to produce desired video output signals.
- 1    9.    The switcher of claim 1 further comprising a storage unit electrically coupled to  
2        the control and general purpose processor units for storing video signals.

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- 1   10.   The switcher of claim 1 further comprising a network interface unit electrically  
2       coupled to the general purpose processor unit for receiving input signals and for  
3       providing output signals over a local area network or a wide area network.
- 1   11.   The switcher of claim 1 further comprising a digital video effects unit electrically  
2       coupled to the control and general purpose processor units for processing of video  
3       input signals for generating special effects video output signals.
- 1   12.   The switcher of claim 11 wherein the special effects video output signals include  
2       page curls, flying video cubes, water ripples, spheres, highlights and shadows, and  
3       slats and waves.
- 1   13.   The switcher of claim 1 further comprising a multi-function video effects unit  
2       electrically coupled to the control and general purpose processor units for  
3       providing JPEG clip store, still store and slow motion processing capabilities.
- 1   14.   The switcher of claim 1 further comprising a post-production digital video effects  
2       unit electrically coupled to the control and general purpose processor units for  
3       non-real time processing of video input signals for generating special effects video  
4       output signals.
- 1   15.   The switcher of claim 1 wherein the control processor unit runs a closed  
2       architecture operating system.
- 1   16.   A digital video switcher for processing video signals in a production environment  
2       comprising:  
3           a switching unit for receiving video input signals and for providing video  
4           output signals;  
5           a control processor unit, electrically connected to the switching unit, for  
6           controlling production functions and being capable of providing control signals

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that program the switching unit to provide desired video output signals in real time;

at least one configurable input device for receiving operator inputs; and a general purpose processor unit electrically connected to the switching unit and the control processor unit, and in electrical communication with the at least one configurable input device, the general purpose processor unit running an open architecture operating system and being capable of providing control signals, wherein a portion of the control signals are provided in response to operator inputs received from the at least one configurable input device, such control signals programming the switching unit to provide desired video output signals in real time;

the general purpose processor unit and the control processor unit being synchronized to the video frame rate, tightly coupled to and independent of each other.

17. The switcher of claim 16 further comprising a dual port memory electrically connected to the control processor unit and the general purpose processor unit.

18. The switcher of claim 17 wherein the control processor unit and the general purpose processor unit share a section of the dual port memory to allow for high bandwidth communications.

19. The switcher of claim 16 further comprising a second general purpose processor, in communication with the general purpose processor, for running an open architecture operating system and providing control signals, wherein a portion of the control signals are provided in response to operator inputs received from the at

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- 5       least one configurable input device, such control signals programming the  
6       switching unit to provide desired video output signals in real time.
- 1   20.   The switcher of claim 16 wherein the control processor unit further comprises at  
2       least one control processor.
- 1   21.   The switcher of claim 16 wherein the general purpose processor unit is running a  
2       Windows NT operating system.
- 1   22.   The switcher of claim 16 further comprising at least one mix/effects amplifier  
2       electrically coupled to the switching unit and the control and general purpose  
3       processor units, the at least one mix/effects amplifier, in response to control  
4       signals from the control and general purpose processor units, combining selected  
5       video input signals to produce desired video output signals.
- 1   23.   The switcher of claim 16 further comprising a storage unit electrically coupled to  
2       the control and general purpose processor units for storing video signals.
- 1   24.   The switcher of claim 16 further comprising a network interface unit electrically  
2       coupled to the general purpose processor unit for receiving input signals and for  
3       providing output signals over a local area network or a wide area network.
- 1   25.   The switcher of claim 16 further comprising a digital video effects unit  
2       electrically coupled to the control and general purpose processor units for  
3       processing of video input signals for generating special effects video output  
4       signals.
- 1   26.   The switcher of claim 25 wherein the special effects video output signals include  
2       page curls, flying video cubes, water ripples, spheres, highlights and shadows, and  
3       slats and waves.

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- 1 27. The switcher of claim 16 further comprising a multi-function video effects unit  
2 electrically coupled to the control and general purpose processor units for  
3 providing JPEG clip store, still store and slow motion processing capabilities.
- 1 28. The switcher of claim 16 further comprising a post-production digital video  
2 effects unit electrically coupled to the control and general purpose processor units  
3 for non-real time processing of video input signals for generating special effects  
4 video output signals.
- 1 29. The switcher of claim 16 wherein the control processor unit runs a closed  
2 architecture operating system.
- 1 30. A configurable input device for receiving operator inputs to command a digital  
2 video switcher for processing a plurality of video signals comprising:  
3 a display for displaying messages;  
4 a plurality of configurable input elements for receiving operator inputs;  
5 and  
6 a transceiver in communication with the display and the plurality of input  
7 elements, the transceiver receiving from (i) the plurality of configurable input  
8 elements, signals in response to an operator action and (ii) an external source,  
9 configuration information about the plurality of configurable input elements, and  
10 a data set that is displayed on the display.
- 1 31. The configurable input device of claim 30 wherein at least one configurable input  
2 element of the plurality of configurable input elements further comprises a display  
3 for displaying a color that represents a type of command to which the configurable  
4 input element corresponds.

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- 1 32. The configurable input device of claim 30 wherein at least one configurable input  
2 element of the plurality of configurable input elements further comprises a display  
3 for displaying one of a textual and a graphical representation of the command to  
4 which the configurable input element corresponds.
- 1 33. The configurable input device of claim 30 wherein the transceiver receives from  
2 an external source a data set that is displayed on the display.

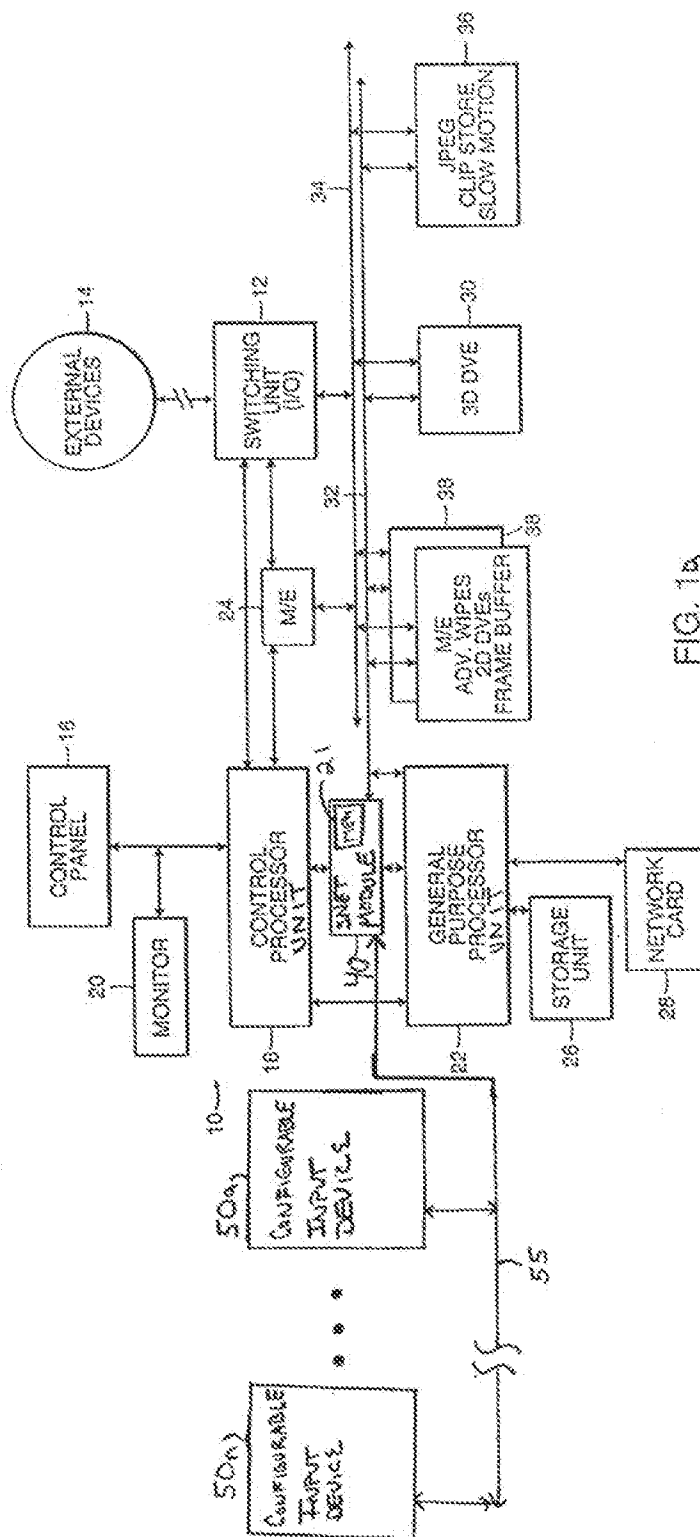
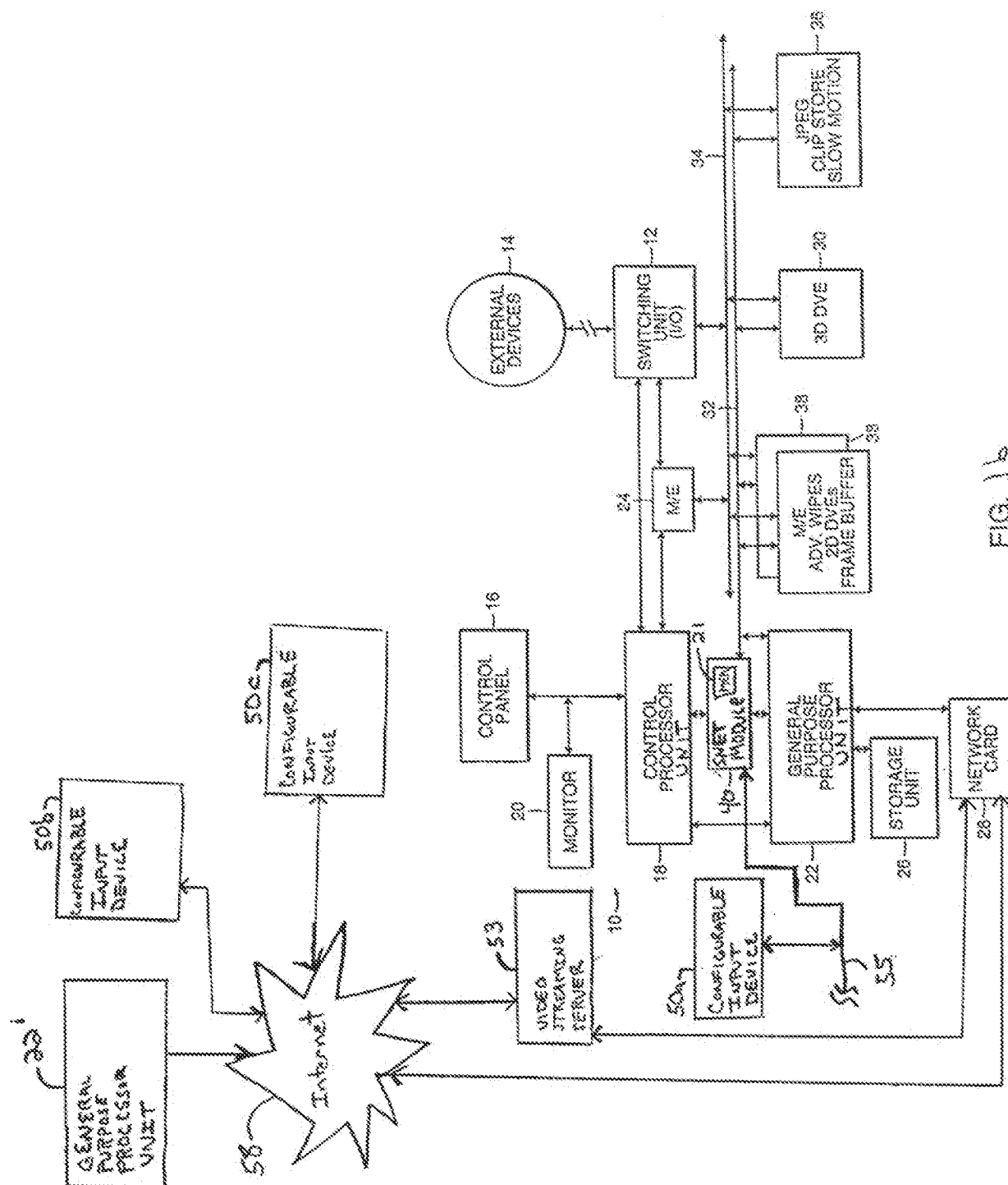


FIG. 1a



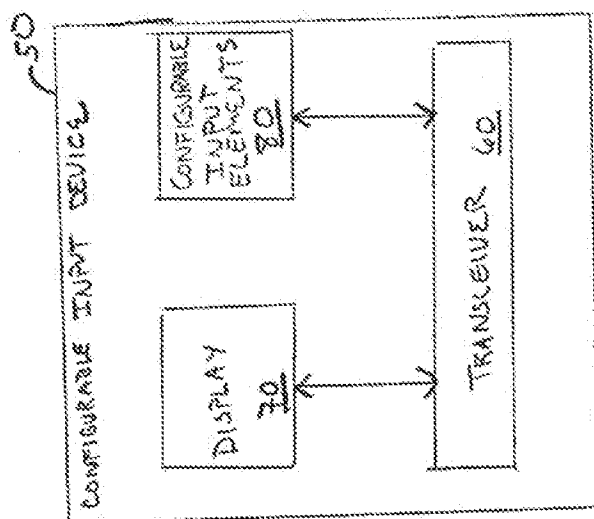
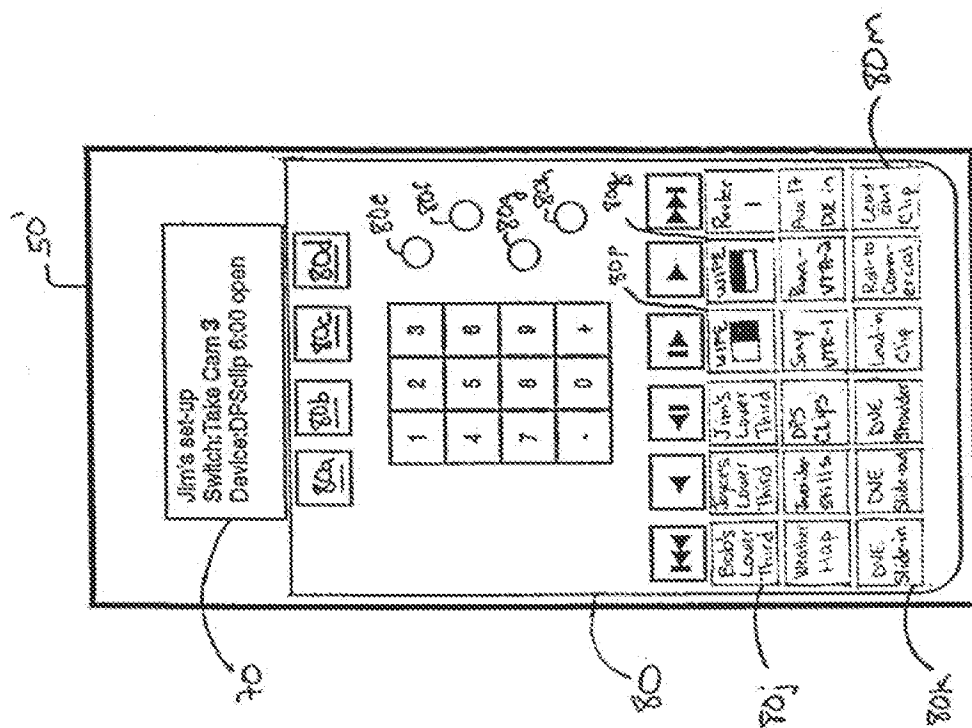


FIG. 2

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# INTERNATIONAL SEARCH REPORT

Inter. Natl. Application No.

PCT/US 00/09032

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04N5/262 H04N5/268

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, COMPENDEX, IBM-TDB, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 162 904 A (BEAULIER DANIEL A ET AL) 10 November 1992 (1992-11-10) column 3, line 54 -column 5, line 33 column 11, line 25 -column 14, line 17 figures 14B, 16, 17	1, 16
A	YAGI N ET AL: "A PROGRAMMABLE REAL-TIME VIDEO SIGNAL-PROCESSING SYSTEM" SMPTE JOURNAL, US, SMPTE INC. SCARSDALE, N.Y., vol. 100, no. 11, 1 November 1991 (1991-11-01), pages 860-868, XP000213667 ISSN: 0036-1682 page 863, middle column page 864, right-hand column, line 64 -page 867, left-hand column, line 48	1, 16
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

5 July 2000

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# INTERNATIONAL SEARCH REPORT

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## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	US 5 982 456 A (CARLSON GREG ET AL) 9 November 1999 (1999-11-09) the whole document	1, 16

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

PCT/US 00/09032

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5162904	A	10-11-1992	NONE	
US 5982456	A	09-11-1999	NONE	